

13.0 ROADWAYS

13.1 Administrative Requirements

The Contractor shall comply with the requirements of the following manuals and standards (latest versions at Proposal Due Date) for the design and construction of the Work for the Project.

13.1.1 US 6, I-25, Federal Blvd., Bryant St., 5th Avenue, Interchange Ramps, Collector-Distributor Roads, Weir Gulch Trail and Platte River Bikeway

1. CDOT Roadway Design Guide
2. AASHTO, A Policy on Geometric Design on Highways and Streets
3. AASHTO, Roadside Design Guide
4. CDOT, Standard Plans List, M & S Standards
5. CDOT, Standard Specifications for Road and Bridge Construction
6. AASHTO, Guide for the Development of Bicycle Facilities
7. United States Access Board, ADA Accessibility Guidelines for Buildings and Facilities
8. United States Access Board, *Revised Draft Guidelines* for Accessible Public Rights-of-Way
9. State of Colorado, State Highway Access Code
10. City and County of Denver, Transportation Standards and Details for the Engineering Division

13.1.2 Local Roadways

Local Roadways include Federal Blvd., 5th Avenue,, Bryant Street, Canosa Court and other non-CDOT roadways impacted by the Project.

Roadways controlled or maintained by Local Agencies other than CDOT shall be designed and constructed according to the Local Agency's standards and requirements. The additional manuals and standards are as follows:

1. City and County of Denver, Transportation Standards and Details For The Engineering Division
2. CCD, Traffic Signal Standards
3. CCD, Sign & Marking Standards.....

13.2 Design Requirements

13.2.1 Design and Plan Submittals

In addition to the submittal requirements specified in this Section, the Contractor shall submit design and plan documents for CDOT Approval and Acceptance, as required in Book 2, Section 3 - Quality Management.

13.2.2 General Design Requirements by Project Element

13.2.2.1 Basic and Ultimate Configuration Accommodation

The infrastructure constructed with the Project shall consider and accommodate the ultimate configuration improvements, including but not limited to horizontal/vertical geometry and clearances to structures.

The Contractor shall prepare and submit for Acceptance the preliminary design plans of the Ultimate Configuration elements in consideration of the Basic Configuration for the Project and prior to issuance of Released for Construction plans.

13.2.3 Cross Slope and Superelevation

13.2.3.1 Normal Cross Slope

All new and reconstructed pavement sections shall have a normal cross slope of 2 percent.

For pavement widening sections, the widened section will have a normal cross slope of 2 percent.

For overlay sections where the existing cross slope is equal or greater than 2 percent, the Contractor shall maintain the existing pavement cross slope. For overlay sections where the existing cross slope is less than 2 percent, the cross slope shall be built-up through the use of a variable thickness overlay to a minimum of 2 percent.

13.2.3.2 Superelevation Rates

Superelevation run out and runoff lengths for US 6, I-25, Collector Distributor Roads, and Interchange Ramps shall be designed based on the ultimate configuration.

Superelevation transition design shall comply with the design criteria and methodology of AASHTO, A Policy on Geometric Design on Highways and Streets, the current CDOT Roadway Design Guide, and CDOT, Standard Plans List, M & S Standards

13.2.4 Stopping Sight Distance

Stopping sight distances and decision sight distances shall meet or exceed the requirements of Exhibit 13-1- Roadway Design Criteria Table in this Section. Stopping sight distances shall be determined in accordance with the AASHTO, A Policy on Geometric Design on Highways and Streets and CDOT Roadway Design Guide.

13.2.5 Fill and Cut Slopes and Clear Zones

The Contractor shall design cut and fill slopes to obtain clear zones and avoid the need for guardrail wherever possible. Where clear zones cannot be obtained within CDOT ROW, guardrail shall be required.

Clear zones shall be designed in accordance with the recommendations of the AASHTO Roadside Design Guide.

13.2.5.1 Roadside Slopes Adjacent to Pavement

(Note: All slopes stated herein are in terms of horizontal: vertical)

The Point of Slope Selection (POSS) is defined as the location at which the roadside slope adjacent to the pavement ends and the cut or fill slope begins. Width and slope of the area between the edge of pavement (or sidewalk) and the POSS shall be as follows:

1. Mainline US 6 and I 25: 12 feet minimum at a 6:1 slope
2. Collector-Distributor Roads: 12 feet at a 6:1 slope
3. Ramps: 12 feet at a 6:1 slope
4. Curb and sidewalk areas: 2 feet at a 50:1 slope

13.2.5.2 Fill Slopes

Fill slopes beyond the POSS shall be designed and constructed in accordance with the following priority.

1. Use 6:1 slopes where fill heights are less than 4 feet, and matches with existing conditions that can be obtained within the Project limits.
2. Use 4:1 slopes where fill heights are greater than 4 feet but less than 10 feet, and matches with existing conditions that can be obtained within the Project limits.
3. Where the above conditions cannot be obtained, and as accepted as a variance by the Contractor's Engineer, the Contractor may use any of the following design approaches:
 - A. Use 3:1 slopes with guardrail protection. Slopes steeper than 4:1 shall incorporate the use of soil retention blankets in compliance with the requirements of Section 17 - Landscaping.
 - B. Use retaining walls as necessary, with guardrail protection. Where retaining walls are used, provide a traversable surface with a maximum 6:1 cross slope and a minimum 10 feet width between face of wall and ROW or Permanent Easement line, fence line, or other obstruction.

Fill slope areas shall be designed to prevent roadside and slope drainage from flowing onto adjacent properties.

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13.2.5.3 Cut Slopes

Cut slopes beyond the POSS shall be designed and constructed in accordance with the following priorities:

1. Cut slopes must be transitioned at the match with the 6:1 slopes adjacent to roadway pavement in such a manner to comply with the recommendations of the AASHTO Roadside Design Guide.
2. Use 4:1 or flatter slopes for cut slopes where matches with existing conditions can be obtained within the Project limits.
3. Where the above conditions cannot be obtained, and as accepted as a variance by the Contractor's Engineer, the Contractor may use any of the following design approaches:
 - A. Use 3:1 slopes with guardrail protection. Slopes steeper than 4:1 shall incorporate the use of soil retention blankets in compliance with the requirements of Section 17 - Landscaping.
 - B. Use retaining walls as necessary, with guardrail protection to match existing conditions within the Project limits. Where retaining walls are used, locate to avoid landscaping and maintenance areas of less than 10 feet in width.

13.2.6 - Intentionally Left Blank -

13.2.7 Guardrail

Guardrail shall be required wherever clear zone requirements cannot be achieved.

Median barrier is required along the entire length of US 6 and I-25. Median barrier shall be concrete barrier with a concrete glare screen in accordance with CDOT Standard M-606-13.

Guardrail along outside shoulders of US 6, I-25, Collector-Distributor Roads, and Interchange Ramps shall be concrete barrier where inlets are required for pavement drainage. Type 3 guardrail with asphalt curb will not be allowed for drainage accommodation.

All concrete barrier shall be cast-in-place. Precast barrier is not allowed for permanent installations.

13.2.8 Access Design

The Contractor shall construct connecting roads, driveways, or curb cuts to provide access to property parcels where existing accesses have been disturbed or modified. Access design and location shall conform to the following requirements, in the order of precedence listed:

1. Access locations and restrictions delineated on the ROW Plans in Book 4
2. Access locations as required for maintenance operations
3. State of Colorado, State Highway Access Code

Connecting roads and driveways shall be paved to the ROW limits using similar pavement as the adjacent roadway, and shall be replaced in-kind to the limits required to match existing grade.

13.2.9 Bikeway

13.2.9.1 Bikeway Values

The Platte River Bikeway is to be a commuter facility. The Bikeway design shall:

1. Maximize Bikeway user safety.
2. Minimize Bikeway out-of-direction travel.
3. Provide horizontal and vertical separation from mainline US 6 and I 25 that minimizes the need for barrier separation from mainline in the initial and ultimate conditions.
4. Meets CCD requirements.

13.2.10 Design Exceptions

13.2.10.1 Identified Design Exceptions

Design exceptions that have been identified by CDOT and may be required for this Project are included in the Section 13 - Roadways. Additional Design exceptions required for the Contractor's design shall be obtained by the Contractor in accordance with the following requirements:

13.2.10.2 Design Exception Process

The Contractor shall comply with the following requirements when requesting a design exception:

1. The Contractor shall submit design exception requests in the form of a letter addressed to the CDOT Project Director for Approval prior to issuance of applicable Released for Construction Documents.
2. The design exception request shall consist of the following items:
 - A. A letter identifying the exception(s) by number, Project number, location, and status (new submittal, resubmittal, etc.)
 - B. A completed CDOT Form 464a
 - C. Supporting documentation indicating the justification for the exception. Justification shall address the following items:
 - (1) Site conditions of the exception.
 - (2) Compelling reason for the exception, including which standard is not being met, if the exception affects any other standards and what will be done to mitigate the effects of the exception.
 - (3) Effects of the exception on safety and operation of the facility.
 - (4) Previous crash history near the location of the exception.

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- (5) Calculations estimating the cost of attaining the design standard and costs of exception as proposed.
- (6) Effect on scenic, historical, or other environmental features.

D. Plan and profile drawings depicting the exception.

Table 13.2-2 US 6 BRIDGES DESIGN BUILD GEOMETRIC EXCEPTIONS					
No.	Element	Item	Design Criteria	Design Exception	Comments
DE-1	I-25	Maximum Profile Grade	4% maximum grade for rolling terrain and 60 MPH design speed	5% maximum grade	Increased grade required to reduce impacted area of I-25
DE-2	US 6	Shoulder widths	12-foot inside shoulders	10-foot inside shoulders	Reduced shoulders to accommodate proposed pedestrian bridge piers
DE-3	WB US 6 CD Road	Shoulder widths	12-foot outside shoulder	8-foot outside shoulder	Reduced shoulders to minimize impacts on north side of roadway to the Robinson Dairy property
DE-4	US 6	Shoulder widths	12-foot outside shoulder 12-foot inside shoulder	4-foot outside shoulder 8-foot inside shoulder	Reduced shoulders to avoid impacts with flyover piers and pier caps at the 6 th Ave structure over I-25.
DE-5	US 6	Superelevation (east of Platte River)	Superelevation rate required for 55 MPH	Normal Crown Section	A Normal crown section can be used east of the Platte River to increase clearance with I-25 flyover structures.
DE-6	I-25/US 6 Interchange Ramps	Design speed	50/45/30 MPH	30 MPH	Reduced design speed due to urban setting and vertical/horizontal constraints
DE-7	I-25/US 6 Loop Ramps	Design speed	30 MPH	25 MPH	Reduced design speed due to urban setting and vertical/horizontal constraints

13.3 Construction Requirements

13.3.2 Guardrail

In areas that allow use of Type 3 guardrail, the Contractor shall use galvanized guardrail (Standard Plan No. M606-1) with steel post. The Contractor shall pave asphalt a minimum of 1 foot behind the new guardrail posts.

13.3.3 Median Cover Material

Median cover material for raised medians constructed by the Project shall match color and texture of median cover material constructed on adjacent roadways.

13.3.4 Fencing

13.3.4.1 Temporary Fencing

Installation of temporary fencing will be required according to ROW acquisition agreements to protect adjacent private property. In remaining areas, temporary fencing should be considered to control construction operations and avoid impacts beyond ROW limits. Temporary fence shall be placed as may be required in Section 5 - Environmental Requirements, Section 17 – Landscaping, and any other section of the Contract.

13.3.4.2 Permanent Fencing

Provide permanent fencing of types and at locations in Table 13.3-1.

Table 13.3-1 PERMANENT FENCING TYPES		
Location	Type	Remarks
Right-of-Way line		Per CDOT Standard M-607-2
Access control between Bikeway and US 6/I-25		Per CDOT Standard M-607-2
Water quality/detention ponds		Per CDOT Standard M-607-2

13.3.4.3 Gates

Provide gates in fences at locations, width and type as specified by requirements of the Contract or other maintaining entities for maintenance access, including CDOT.

13.4 Deliverables

At a minimum, the Contractor shall submit the following to CDOT for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
Preliminary Design Plans for ultimate improvements	Acceptance	With preliminary design plans for related Basic Configuration elements prior to issuance of Released for Construction plans.
Design exceptions	Approval	Prior to issuance of applicable Released for Construction Documents

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DESIGN ELEMENT		I-25	6TH AVE (WEST OF PLATTE RIVER)	6TH AVE (EAST OF PLATTE RIVER)
Roadway Classification				
Roadway Classification		Interstate - Urban	Principle Arterial - Urban	Principle Arterial - Urban
Access Control Classification		Interstate (Full)	-	-
Design Speed				
	Minimum (MPH)	55	60	55
	Desirable (MPH)	60	55	60
	Loop Ramp (MPH)			
Posted Speed Limit Minimum (MPH)		55	55	55
Design Vehicle		WB-67	WB-67	WB-67
Horizontal Alignment Criteria				
Curve Radius For Design Speed Minimum (Ft.)		1060'	1330'	1060'
Curve Radius For Design Speed Desirable (Ft.)		1330'	1660'	1330'
Superelevation (e_{max})		6%	6%	6%
Max. Degree of Curve - Design Speed Minimum (Calculated)		5.41	4.31	5.41
Max. Degree of Curve - Design Speed Desirable (Calculated)		4.31	3.45	4.31
Cross Slope - Normal		2%	2%	2%
Maximum Algebraic Difference at Crossover Line (%)		4 to 5%	4 to 5%	4 to 5%
Clear Zone (On Tangent)				
	Minimum	22'	30'	30'
	Desirable	32'	34'	34'
Clear Zone (On Curve)				
	Minimum	33'	42'	42'
	Desirable	44.8'	47.6'	47.6'
Lane Width (Ft.)		12'	12'	12'
Shoulder Widths				
	Left Inside (Ft.)	12'	12'	12'
	Right Outside (Ft.)	12'	12'	12'
Curb and Gutter Type		N/A	N/A	N/A
Sidewalk Widths		N/A	N/A	N/A
Side Ditches				
	Z slope (6:1)	12'	12'	12'
	Fill Slope	2:1 to 6:1	2:1 to 6:1	2:1 to 6:1

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	Cut Slope	3:1	3:1	3:1
Redirect Taper (Ft.)		65:1 min.	65:1 min.	65:1 min.
Transition Taper for Accel/Decel Lanes		25:1 min.	25:1 min.	25:1 min.
Taper Length Roadway Lane Drop		70:1 Desirable 50:1 min.	70:1 Desirable 50:1 min.	70:1 Desirable 50:1 min.
Vertical Alignment Criteria				
Maximum Grade		4%	6%	6%
Minimum Grade		0.30%	0.30%	0.3%
Min. Vertical Grade Break without a Curve		0.20%	0.20%	0.20%
Min. Vertical Curve Length (Ft.)		180'	195'	180'
K-Value Ranges				
	Crest VC (Minimum)	114	151	114
	Crest VC (Desirable)	151	193	151
	Sag VC (Minimum)	115	136	115
	Sag VC (Desirable)	136	157	136
Sight Distances				
Min. Stopping Sight Distance (Ft.) Minimum				
	Level (Minimum)	495	570'	495'
	3% Downgrade (Minimum)	520	598'	520'
	3% Upgrade (Minimum)	469	538'	469'
	Level (Desirable)	570	645'	570'
	3% Downgrade (Desirable)	598	682'	598'
	3% Upgrade (Desirable)	538	612'	538'
Interchanges Parallel Type Ent./Ex. Terminals				
Taper Length Taper Entrance Terminal (L>1300 Ft.)		between 50:1 & 70:1	between 50:1 & 70:1	between 50:1 & 70:1
Taper Length Parallel Entrance Terminal (L<1300 Ft.)		300' Minimum	300' Minimum	300' Minimum
Taper Length Parallel Exit Terminal		between 15:1 & 25:1	between 15:1 & 25:1	between 15:1 & 25:1
Structure Clearance Criteria				
Highway Underpass Vertical (Ft.)		16.5'	16.5'	16.5'
Local Road Underpass Vertical (Ft.)		16.5'	16.5'	16.5'
Rail Road Structure (Ft.)		23.5'	23.5'	23.5'
Sign Structures and Pedestrian Overpass (Ft.)		17.5'	17.5'	17.5'
Overhead Power Lines Vertical (Ft.)		20.5' to 21.5'	20.5' to 21.5'	20.5' to 21.5'

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DESIGN ELEMENT (CONTINUED)		6TH AVE CD ROAD	INTERCHANGE RAMP	FEDERAL BLVD
Roadway Classification				
Roadway Classification		Collector-Distributor Road	Interchange Ramps	
Access Control Classification		-	-	
Design Speed				
	Minimum (MPH)	50	50/45/30	
	Desirable (MPH)	55	55/45/30	
	Loop Ramp (MPH)		30	
Posted Speed Limit Minimum (MPH)		45	N/A	
Design Vehicle		WB-67	WB-67	
Horizontal Alignment Criteria				
Curve Radius For Design Speed Minimum (Ft.)		833'	833'/643'/231'	
Curve Radius For Design Speed Desirable (Ft.)		1060'	1060'/643'/231'	
Superelevation (e_{max})		6%	6%	
Max. Degree of Curve - Design Speed Minimum (Calculated)		6.88	6.88	
Max. Degree of Curve - Design Speed Desirable (Calculated)		5.41	5.41	
Cross Slope - Normal		2%	2%	
Maximum Algebraic Difference at Crossover Line (%)		4 to 5%	4 to 5%	
Clear Zone (On Tangent)				
	Minimum	20'	20'	
	Desirable	22'	24'	
Clear Zone (On Curve)				
	Minimum	28'	28'	
	Desirable	33'	34'	
Lane Width (Ft.)		12'	12' (2 lanes) 15' (1 lane)	
Shoulder Widths				
	Left Inside (Ft.)	4'	4'	
	Right Outside (Ft.)	12'	6'-8'	
Curb and Gutter Type		Type 2 (Section I-B, II-B)	Type 2 (Section I-B, II-B)	8'
Sidewalk Widths		N/A	N/A	
Side Ditches				
	Z slope (6:1)	12'	12'	
	Fill Slope	2:1 to 6:1	2:1 to 6:1	
	Cut Slope	3:1	3:1	

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Redirect Taper (Ft.)		65:1 min.	65:1 min.	
Transition Taper for Accel/Decel Lanes		25:1 min.	25:1 min.	
Taper Length Roadway Lane Drop		70:1 Desirable 50:1 min.	70:1 Desirable 50:1 min.	
Vertical Alignment Criteria				
Maximum Grade		6%	3%-5% (45-50 mph) 4%-6% (40 mph) 5%-7% (25-30 mph)	
Minimum Grade		0.3%	0.3%	
Min. Vertical Grade Break without a Curve		0.20%	0.20%	
Min. Vertical Curve Length (Ft.)		165'	150'	
K-Value Ranges				
	Crest VC (Minimum)	84	84/61/19	
	Crest VC (Desirable)	114	114/61/19	
	Sag VC (Minimum)	96	96/79/37	
	Sag VC (Desirable)	115	115/79/37	
Sight Distances				
Min. Stopping Sight Distance (Ft.) Minimum				
	Level (Minimum)	425'	425'	
	3% Downgrade (Minimum)	446'	446'	
	3% Upgrade (Minimum)	405'	405'	
	Level (Desirable)	495'	495'	
	3% Downgrade (Desirable)	520'	520'	
	3% Upgrade (Desirable)	469'	469'	
Interchanges Parallel Type Ent./Ex. Terminals				
Taper Length Taper Entrance Terminal (L>1300 Ft.)		between 50:1 & 70:1	N/A	
Taper Length Parallel Entrance Terminal (L<1300 Ft.)		300' Minimum	N/A	
Taper Length Parallel Exit Terminal		between 15:1 & 25:1	N/A	
Structure Clearance Criteria				
Highway Underpass Vertical (Ft.)		16.5'	16.5'	
Local Road Underpass Vertical (Ft.)		16.5'	16.5'	
Rail Road Structure (Ft.)		23.5'	23.5'	
Sign Structures and Pedestrian Overpass (Ft.)		17.5'	17.5'	
Overhead Power Lines Vertical (Ft.)		20.5' to 21.5'	20.5' to 21.5'	